The Hot Corona of YY Mensae

Marc Audard

Columbia Astrophysics Laboratory

Columbia University, New York

Collaborators

Manuel Güdel (Paul Scherrer Institut)

Stephen L. Skinner (CASA/ U of Colorado)

Roberto Pallavicini (Palermo Observatory)

Stephen A. Drake (NASA Goddard/ USRA)

Rolf Mewe (SRON-Utrecht)

YY Mensae

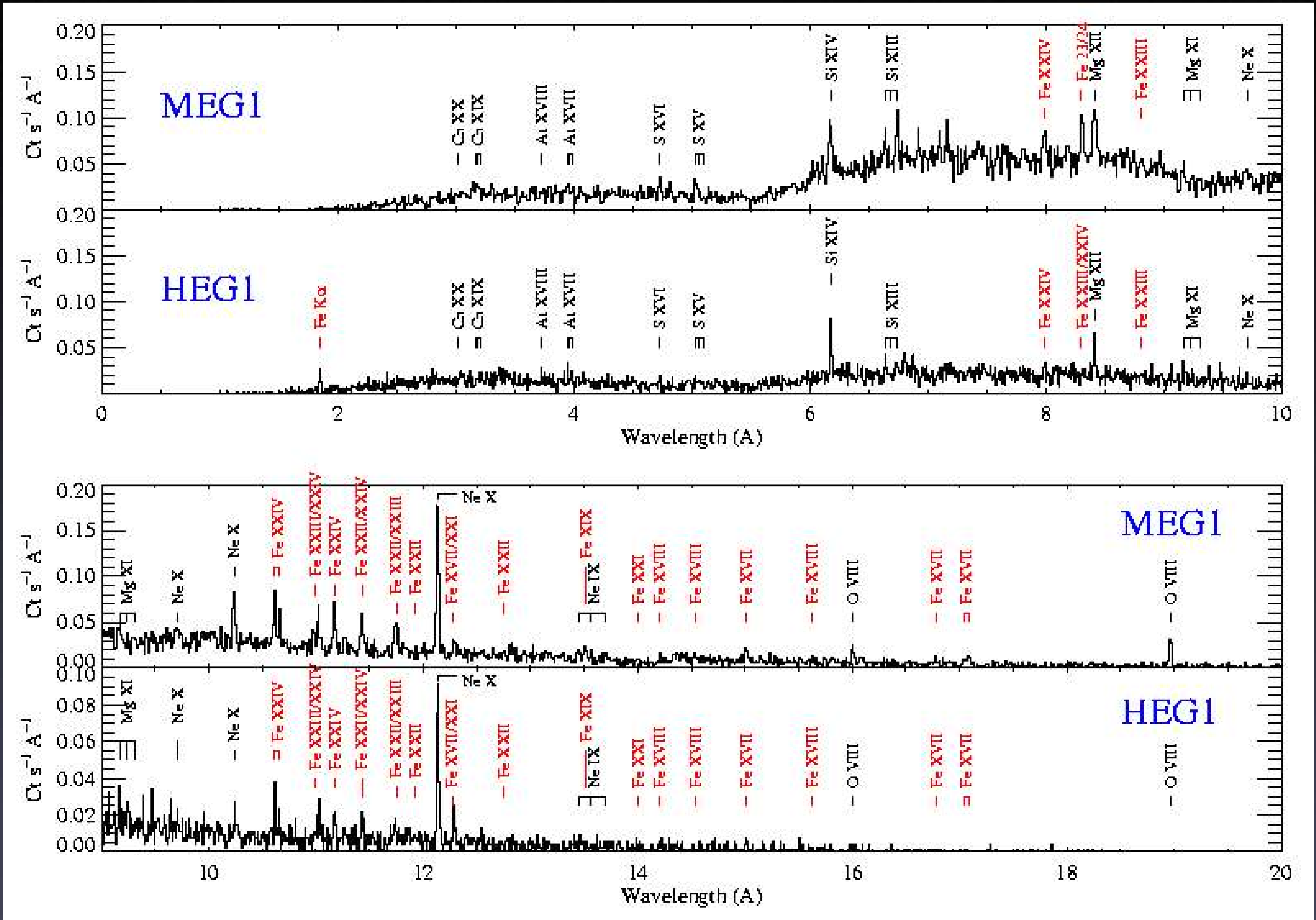
- *YY Mensae is a giant (K1 III) at ~290 pc*
- *It rotates very fast (v sin i ~ 40 km/s; P ~ 9.55 days for R=16 $R_\odot$) ⇒ FK Com-type. Origin unclear:*
  a) *coalescence of rapidly rotating contact binary (Rucinski 1990)*
  b) *progenitor is a rapid rotator (A- and B-type) evolving to the giant phase and developing outer convection zones (Endal & Sofia 1979)*
- *Optical and radio flares lasting several days (Slee et al. 1987; Bunton et al. 1989; Cutispoto et al. 1992)*
- *Low-resolution X-ray spectra suggest dominant plasma of 3 keV, with L_X ~ 10^{32}-$10^{32.7}$ erg/s (Güdel et al. 1996)*

Observations

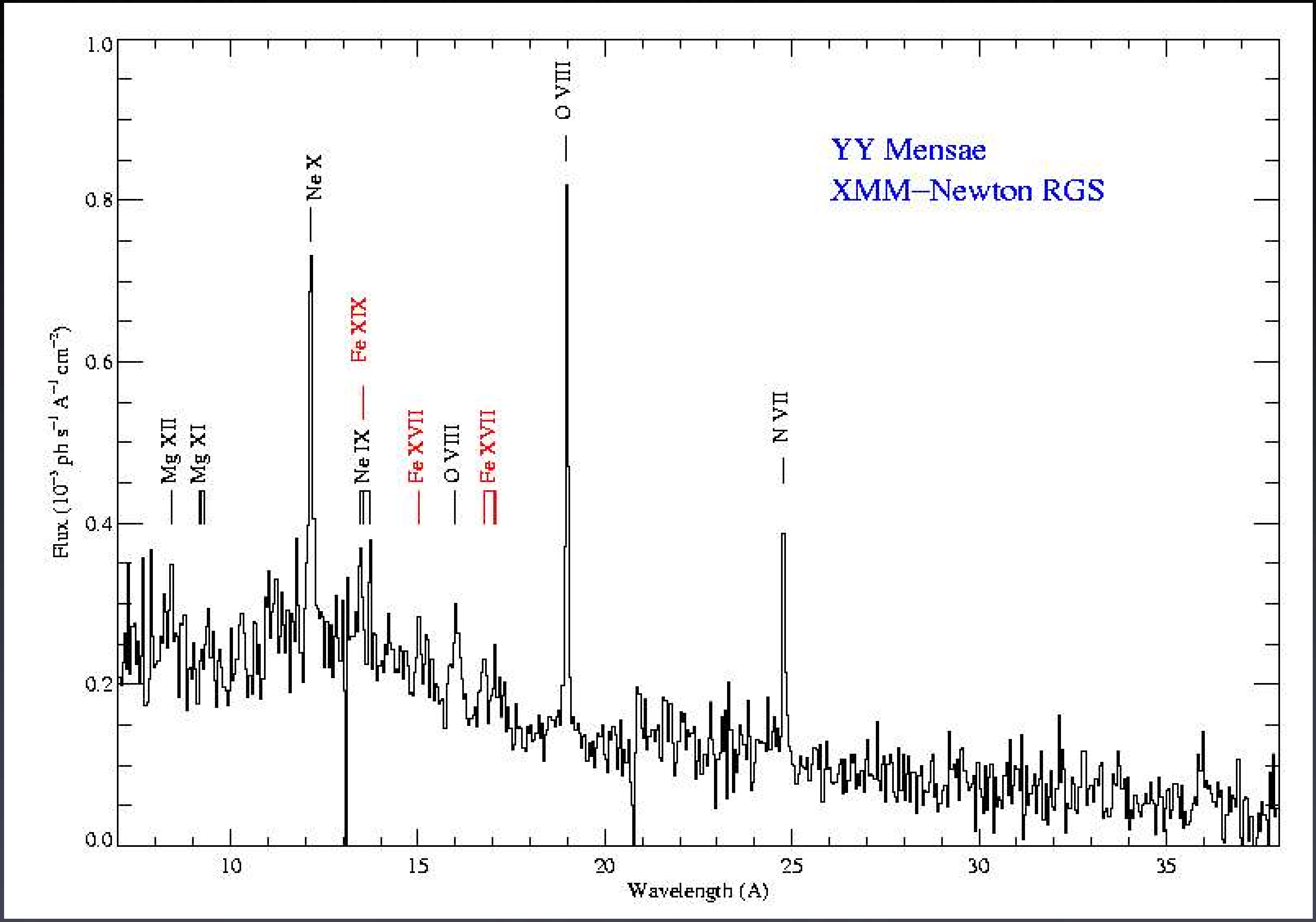
- Chandra ACIS-S/ HETGS
  - 2002 Feb 1–2: 74 ks
  - Count rate (0.35-0.40 ct/ s in MEG1)
- XMM-Newton (EPIC MOS + RGS)
  - 2001 Oct 5-6: 86 ks
  - Count rate (1.4 ct/ s MOS1; 0.37 ct/ s RGS1+2)

➔ Light curves ~ constant (slight decrease)

Chandra HETGS



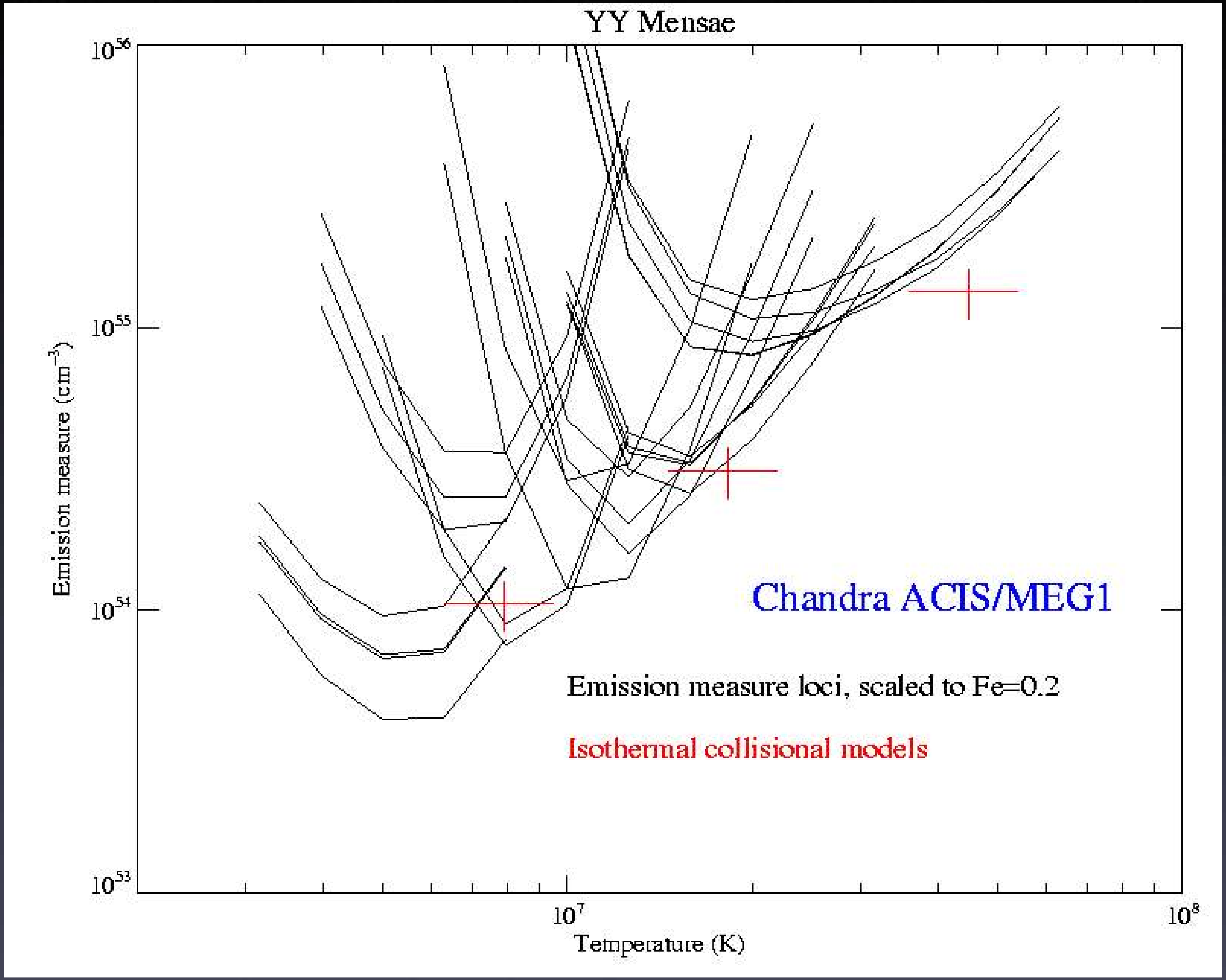
XMM-Newton RGS



Emission measure distribution

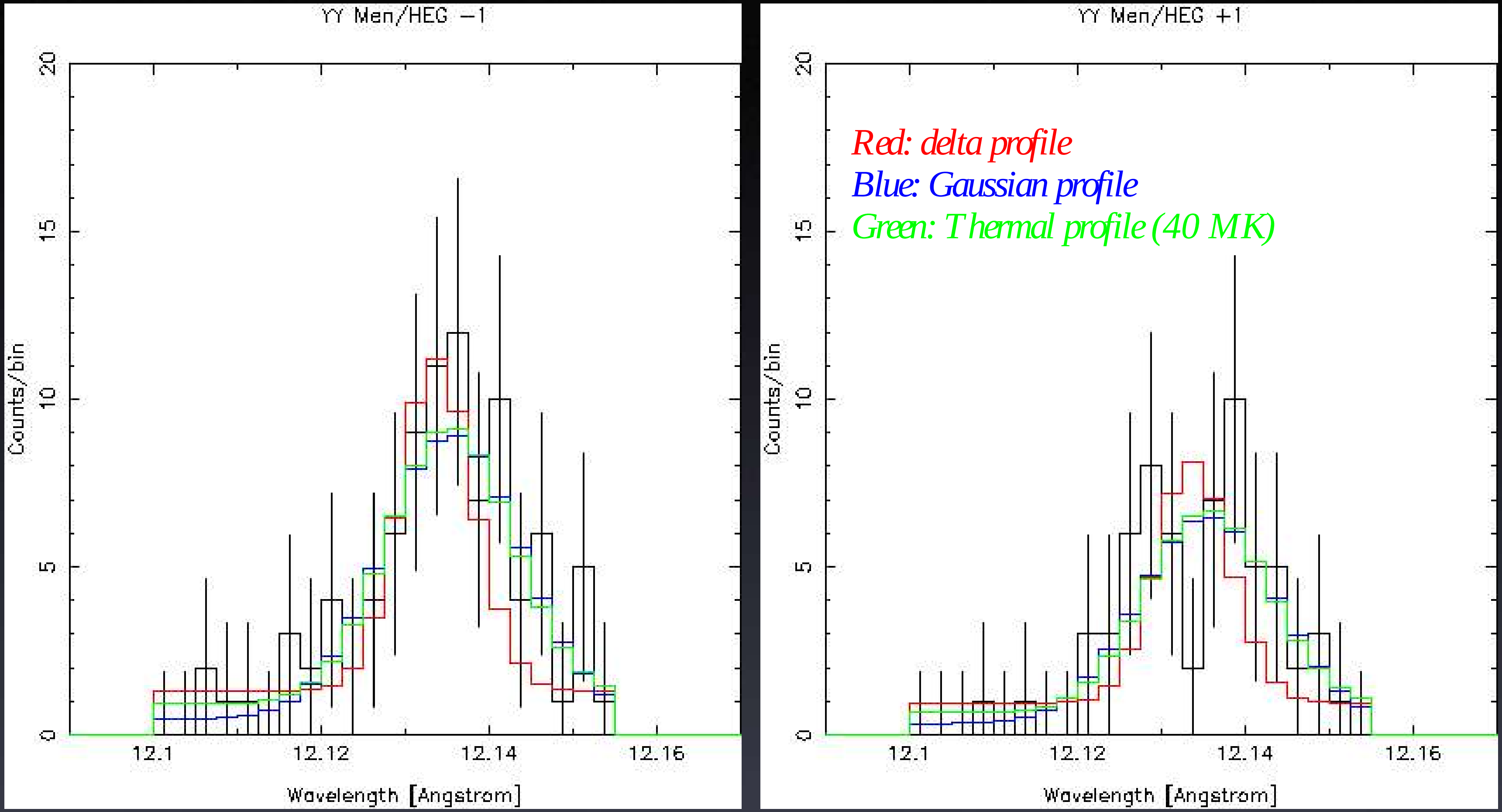
- *Focus on Chandra HETGS*
- *Obtain EM distribution with 2 methods*
  - *Discretization (3-T model); simultaneous fit of continuum and emission lines (incorrect ranges discarded, e.g., 6.90-6.94 Å, 8.28-8.34 Å)*
  - *Determination of continuum (line-free regions), extract fluxes from Fe emission lines, and use line power emissivities to derive upper enveloppe*
- *Compare EM distributions*

Emission measure distribution



- *Dominant plasma ~40 MK*
- *No significant EM < 6 MK*
- *Ne/Fe ~ 5, Ar/Fe ~ 2.5, Mg~Si~Fe*
- *N/Fe ~ 10, and C is very weak (CN cycle)*

Thermal broadening



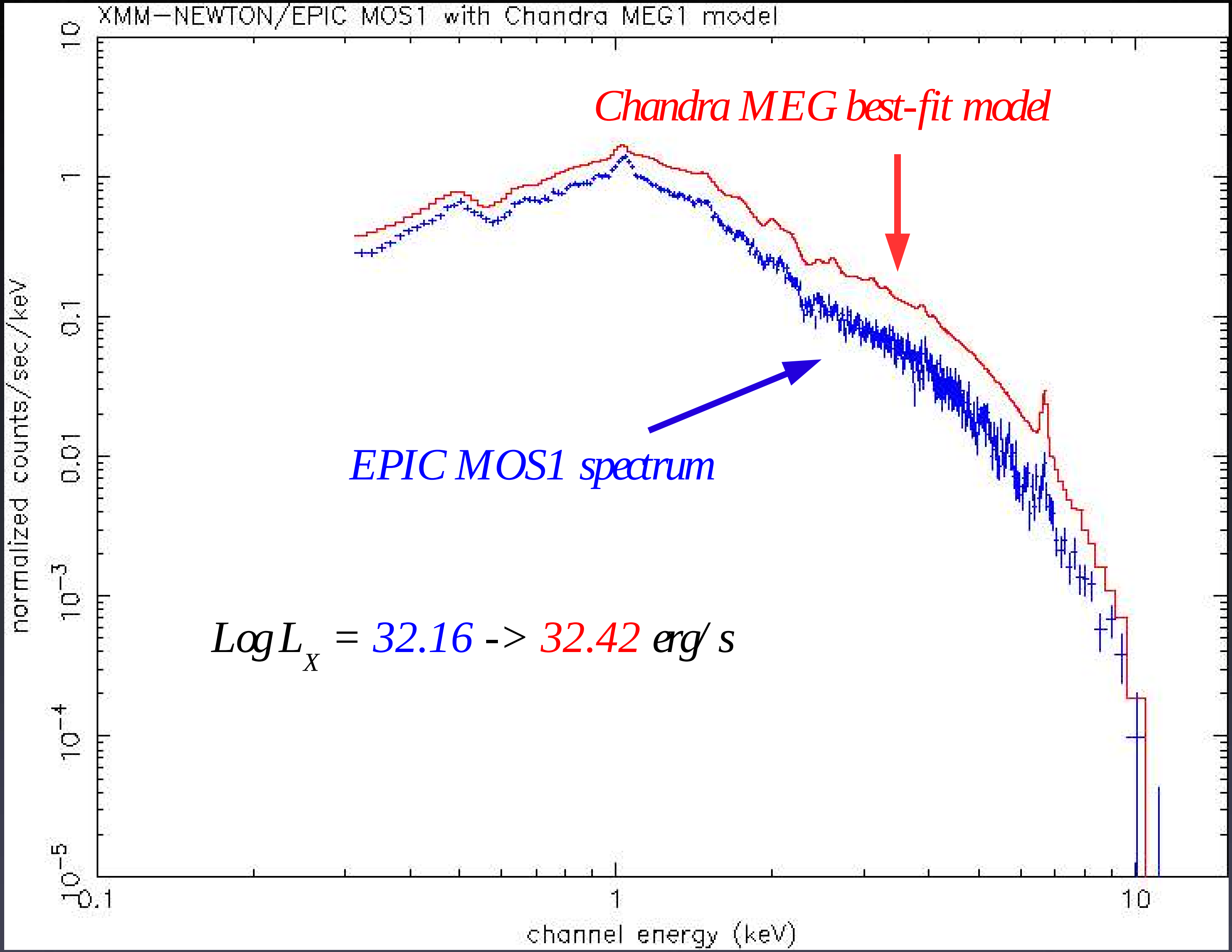
Gaussian with σ *equivalent to T ~ 50-100 MK*

$\sigma = \lambda / c \sqrt{(kT/m)}$*, where m = 20.18 amu (1 amu ~ 1.67E-27 kg)*

XMM-Newton vs Chandra

Despite the lack of flares, the X-ray luminosity varied by a factor of 2 between the observations with XMM-Newton and Chandra

Take the Chandra best-fit model, fold it through the EPIC response matrix, and compare with MOS1 spectrum



Summary

- *YY Mensae displays very hot plasma; its EM distribution increases steeply with temperature (6-40 MK)*
- *The low-FIP abundances are depleted, while the high-FIP abundances are overabundant, inversely to the solar-like FIP effect (N is overabundant & C undetected: CN cycle)*
- *The X-ray luminosity is very high ($L_X \sim 10^{32}$ erg/s) and varied by a factor of 2 without flare activity*
- *Thermal broadening measured in Ne X Ly line*
- *Densities hard to measure, but indication of low densities*
- *Work is ongoing (e.g., EMD, densities, XMM-Newton)*